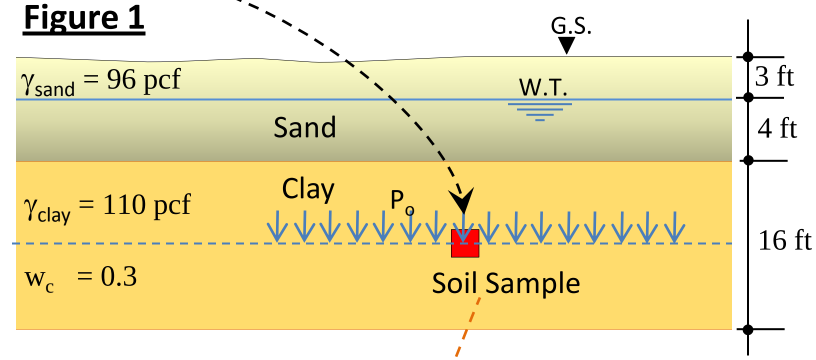
Dr. Kamal Tawfiq - 2010

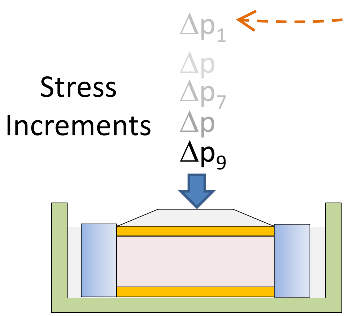
Example:

1. Soil sample was obtained from the clay layer
2. Conduct consolidation test [9 load increments]
3. Plot e vs. log (p) (Figure 2)
4. Determine Compression Index (C_c) & Swelling Index (C_s)

Figure 1



In the lab and after removing the soil sample from the ground, the stresses on the soil sample = 0



In the lab the stresses are added to the soil sample

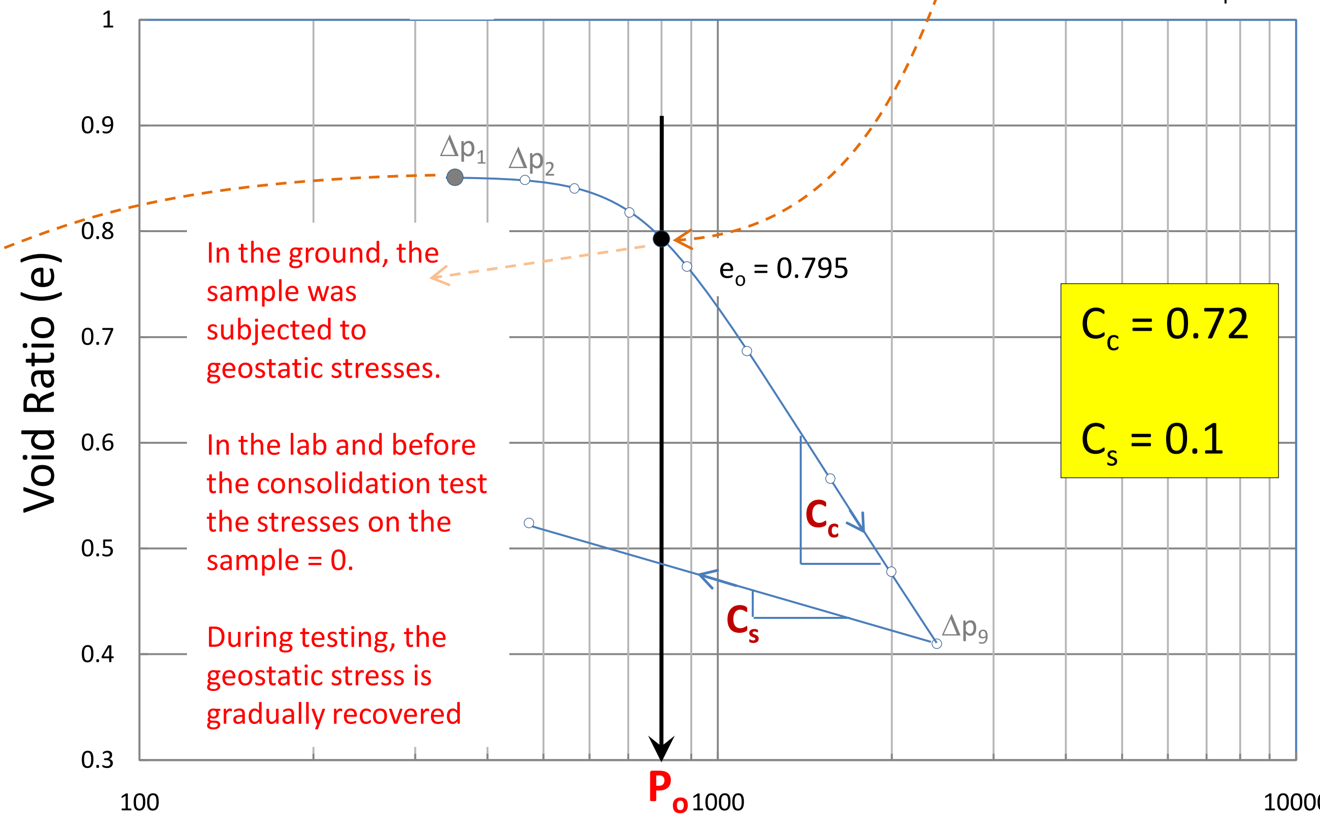


Figure 2

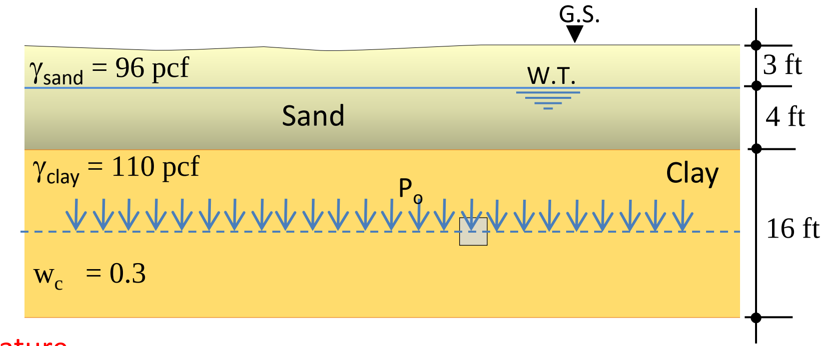
5. Determine $P_o = 3.(96) + 4.(96-62.4) + 8.(110-62.4) = 803.2\ \text{lb/ft}^2$

Tangent to point 1

Example:

6. Using Casagrande's Method to determine Pc

P_c = 800 lb/ft^2



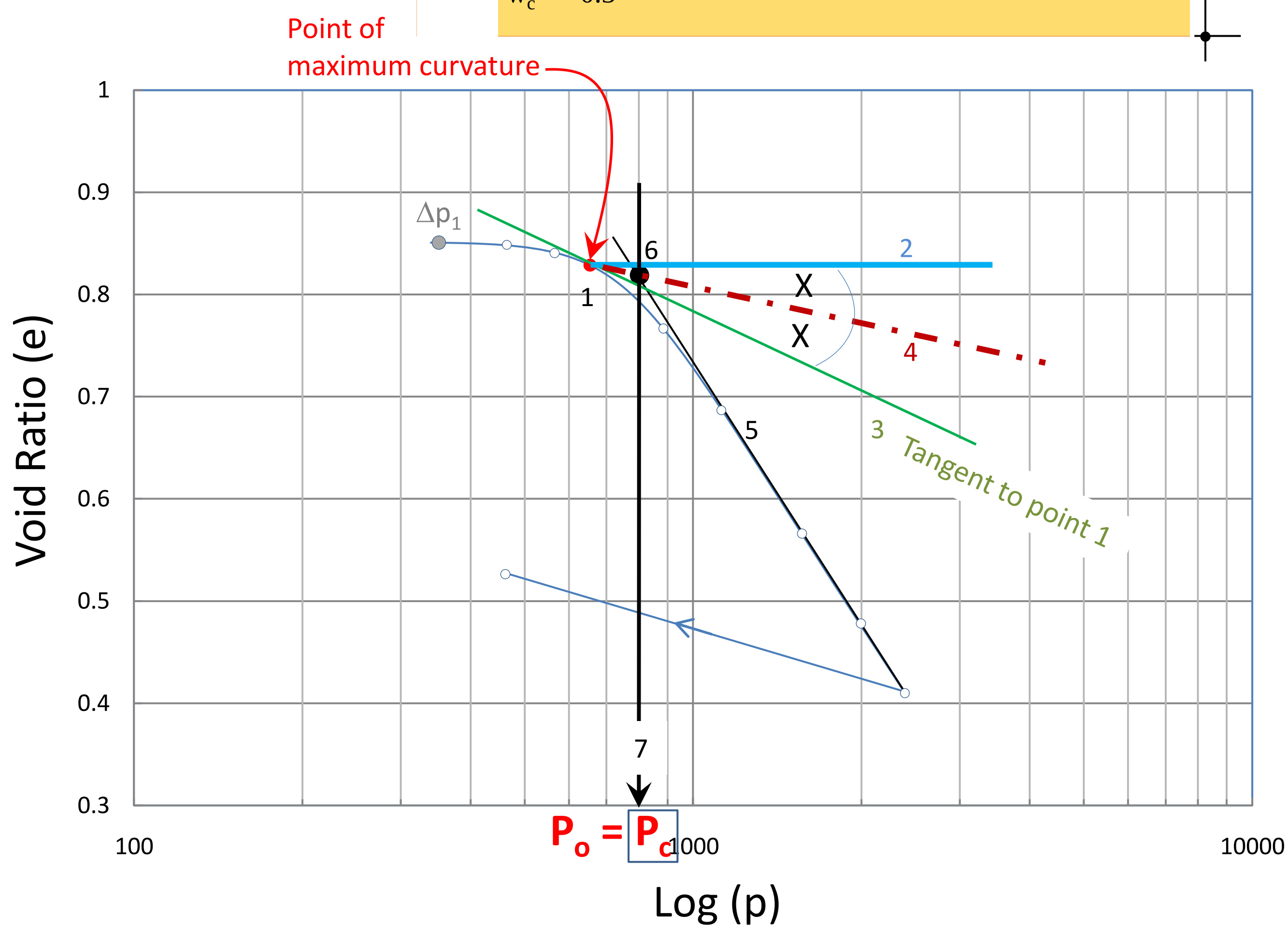
Overconsolidation Ratio

$$OCR = \frac{P_c}{P_o} = 1$$

The soil is

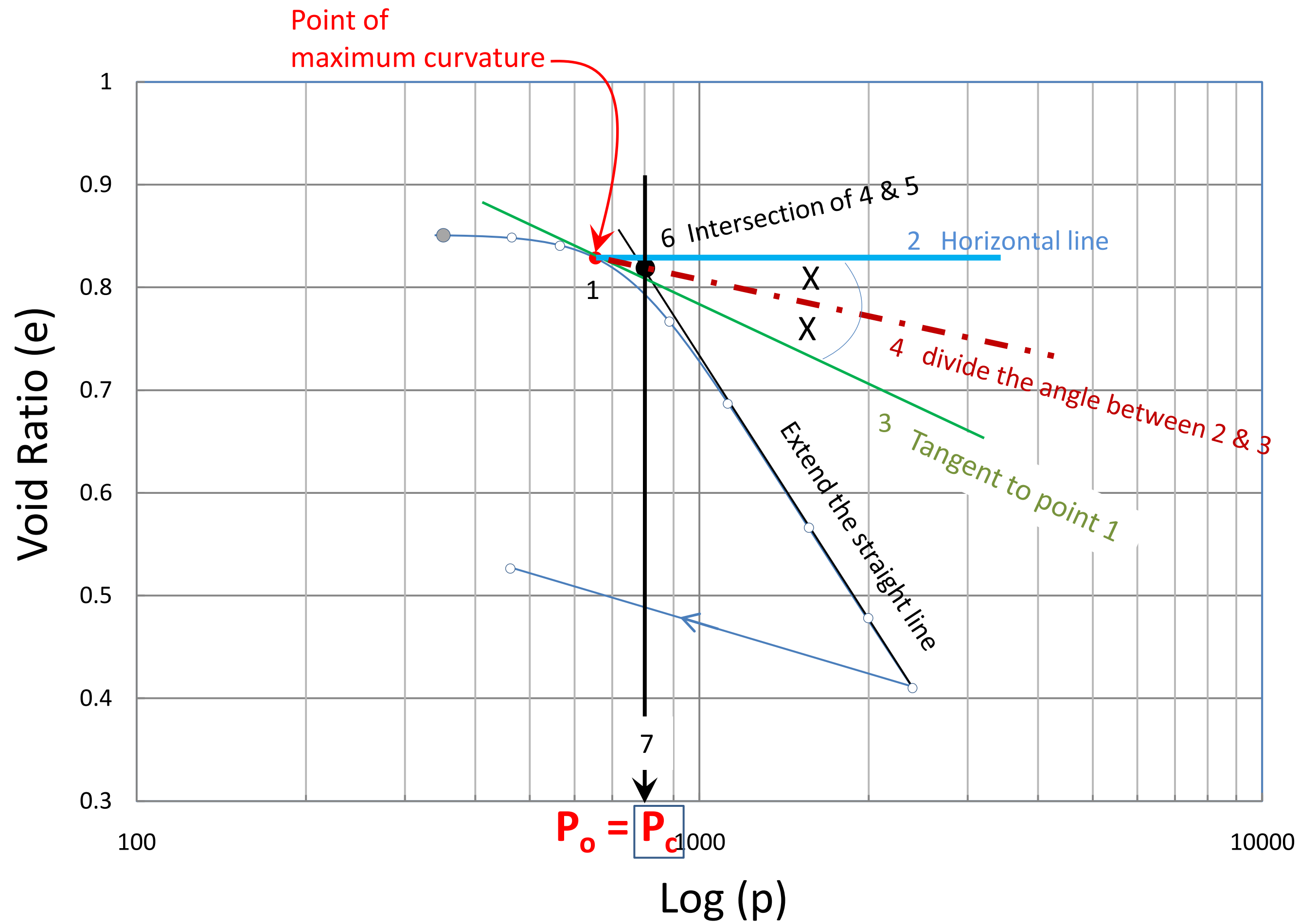
Normally Consolidated

N.C. soil



Casagrande's Method to Determine Preconsolidation Pressure (Pc)

1 Normally Consolidated Soil

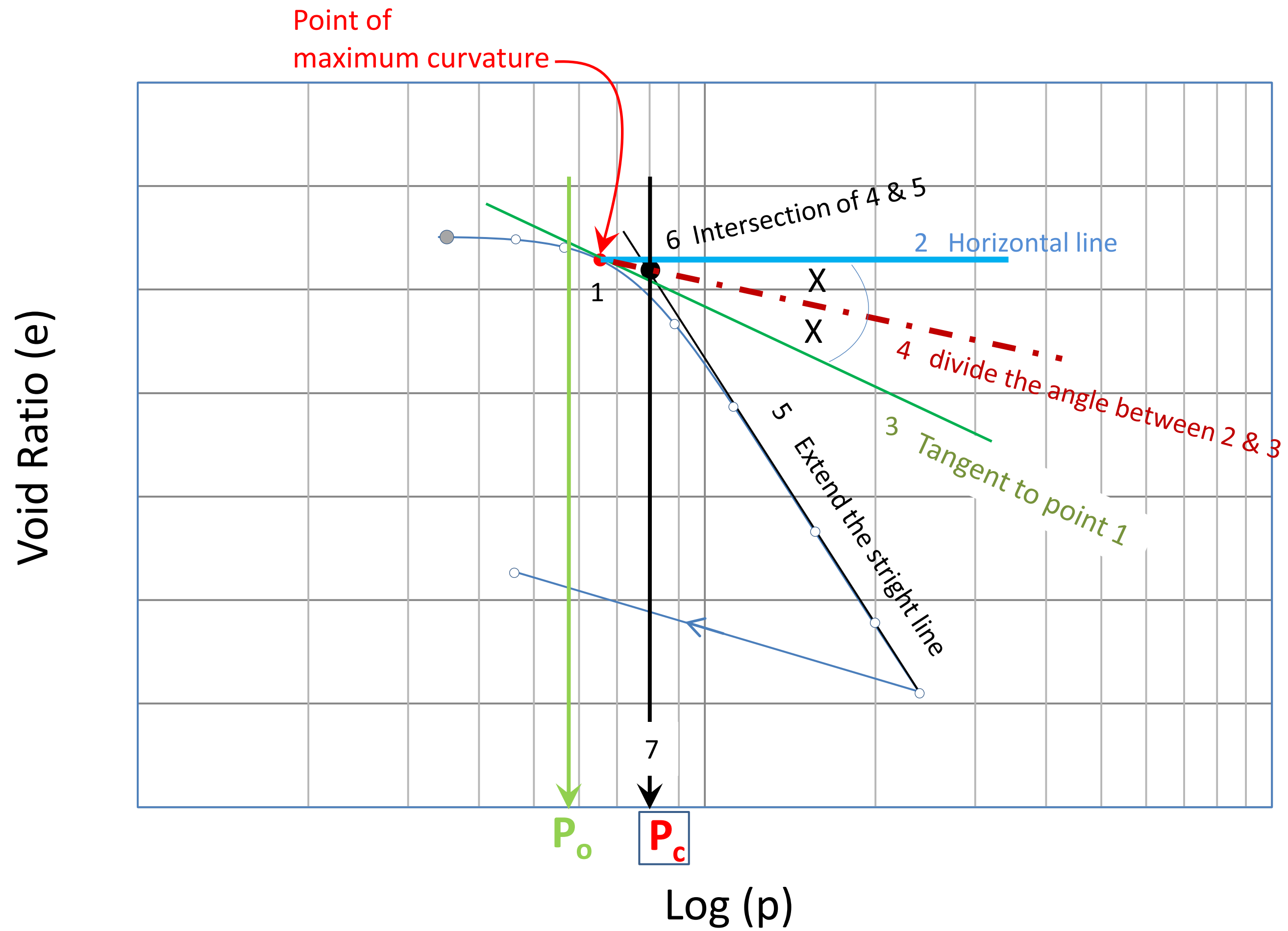


Overconsolidation Ratio OCR $= \frac{P_c}{P_o} = 1$

The soil is **Normally Consolidated** (N.C.) soil

Casagrande's Method to Determine Pc

2 Overconsolidated Soil



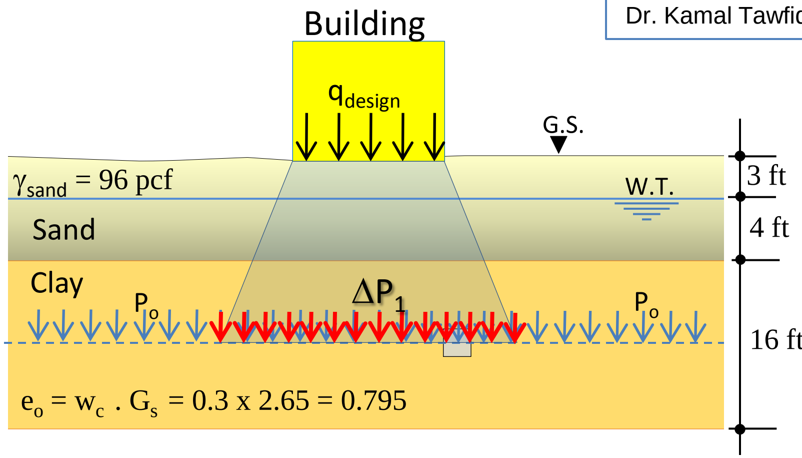
Overconsolidation Ratio OCR = $\frac{P_c}{P_o} > 1$

The soil is **oversonsolidated** (O.C.) soil

Example:

A 150' x 100' building will be constructed at the site. The vertical stress due to the addition of the building q_{design} =1000 lb/ft^2

The weight of the building Q_{design} will be transferred to the mid height of the clay layer



Q_{design} = 15,000,000 lb

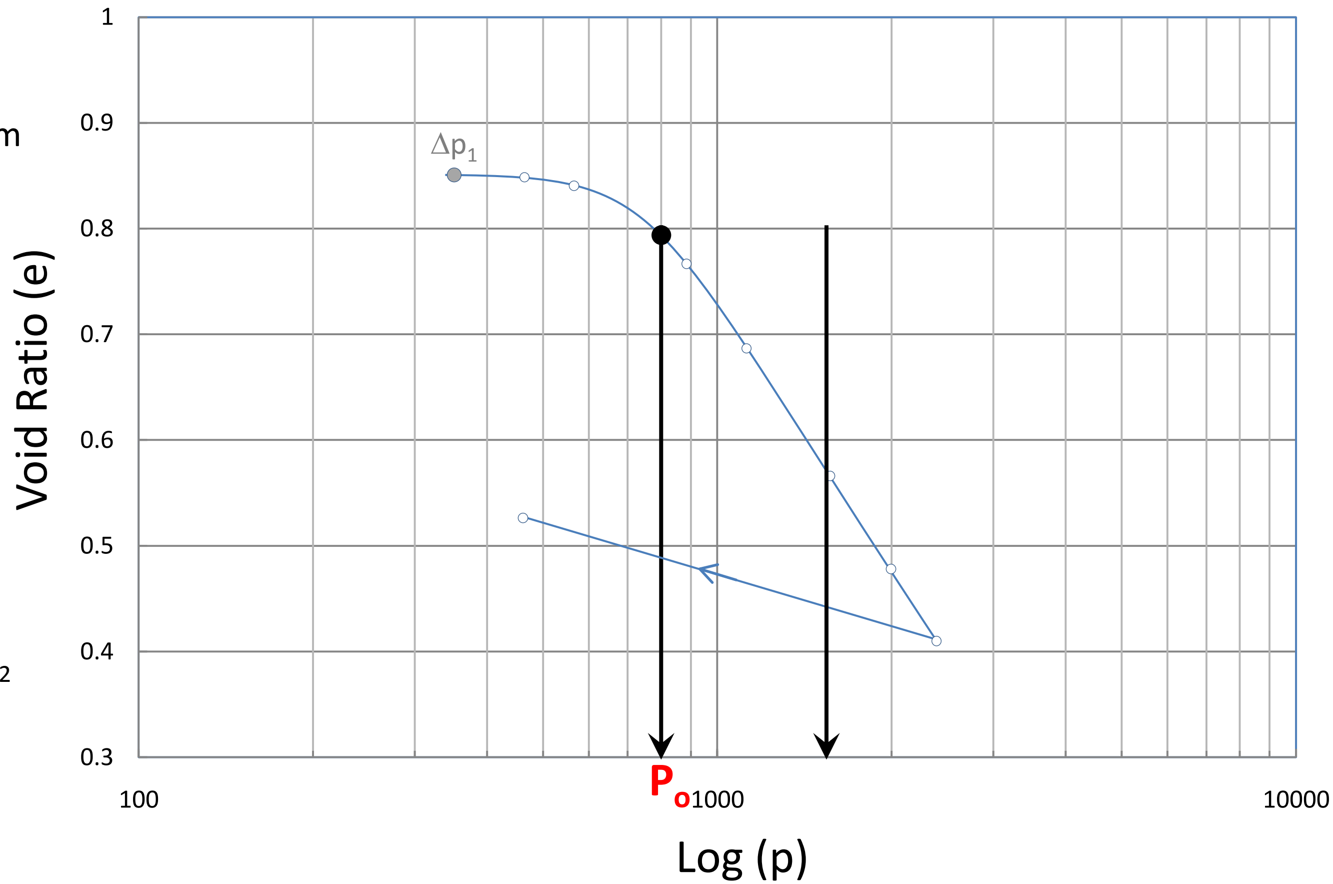
The added stress at 15' from the ground surface is

$$\Delta p = \frac{15{,}000{,}000 \text{ lb}}{(150+15) \times (100+15)}$$

ΔP = 790.51 lb/ft$_2$

$\Delta P + P_o$ =

790.51 + 803 = 1593.51 lb/ft^2



Example:

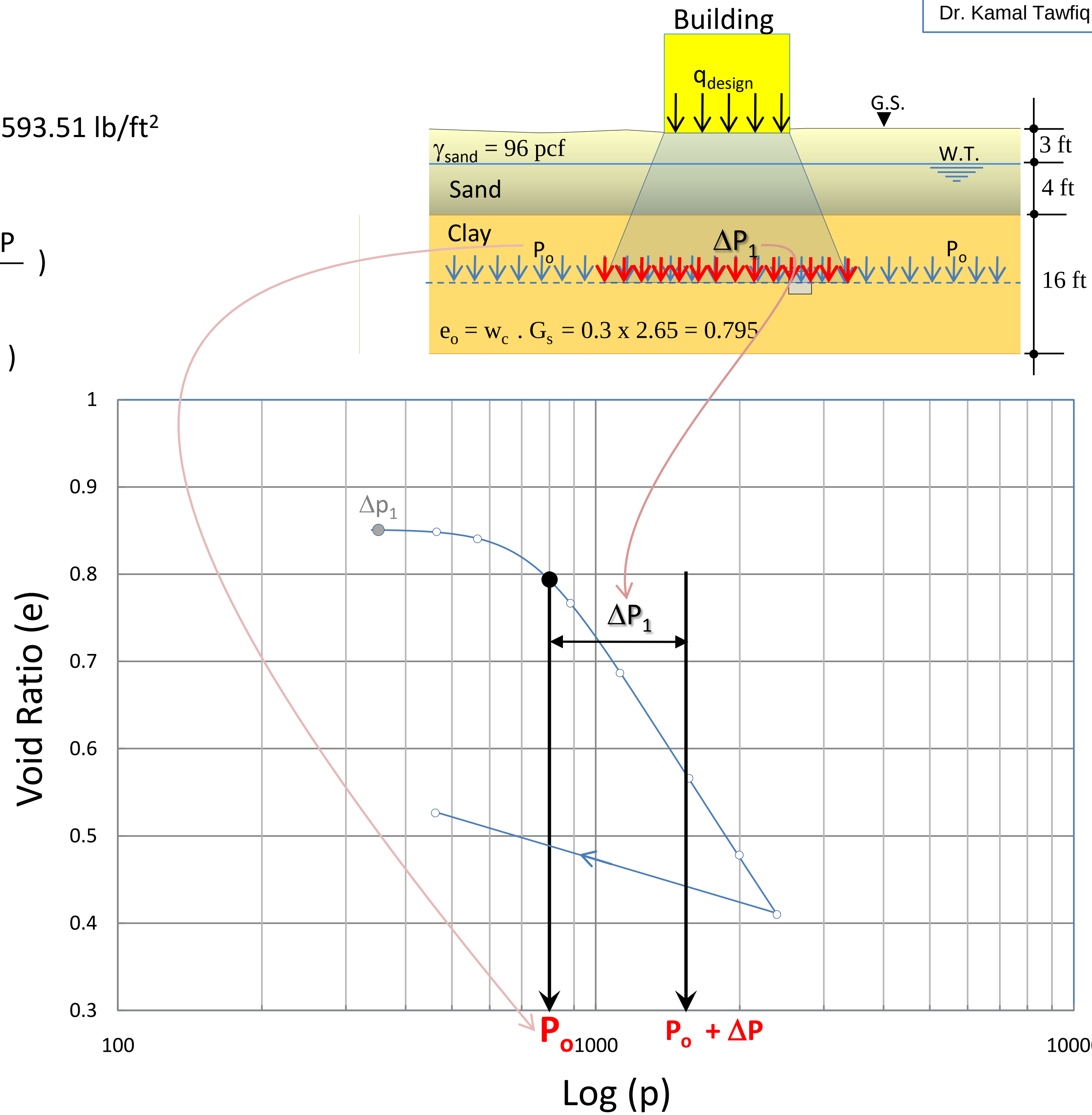
$\Delta P + P_o = 790.51 + 803 = 1593.51 \text{ lb/ft}^2$

Consolidation Settlement

$$\Delta H = \frac{C_c H}{1 + e_O} \log \left(\frac{P_o + \Delta P}{P_o} \right)$$

$$\Delta H = \frac{0.72 \times 16}{1 + 0.795} \log \left(\frac{1593.51}{803} \right)$$

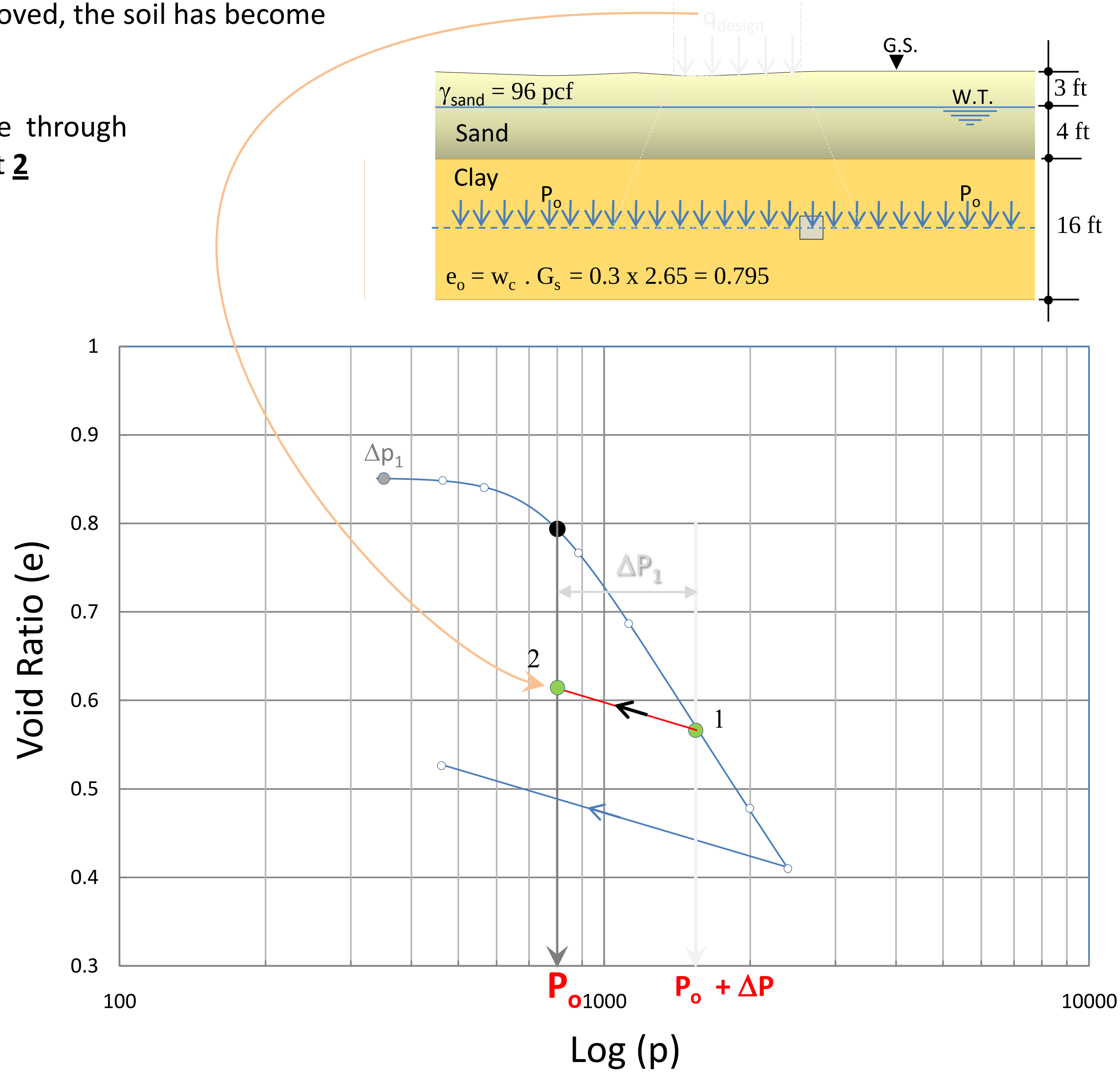
$$\Delta H = 1.9 \text{ ft}$$



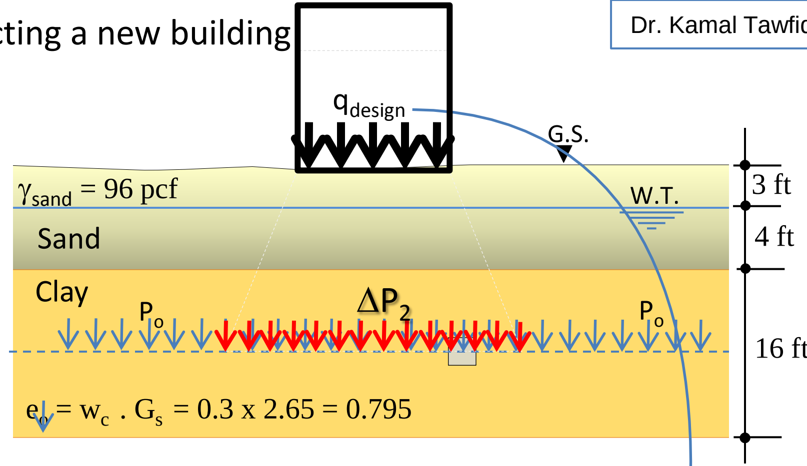
Demolished

When the building was removed, the soil has become an overconsolidated clay.

The rebound has taken place through swelling from pint **1** to point **2**



Constructing a new building



Scenario #1

The soil now is overconsolidated Soil:

The new building is heavier in weight

$$\Delta H = \frac{C_S H}{1 + e_o} \log\left(\frac{P_C}{P_o}\right) + \frac{C_C H}{1 + e_o} \log\left(\frac{P_o + \Delta P}{P_C}\right)$$

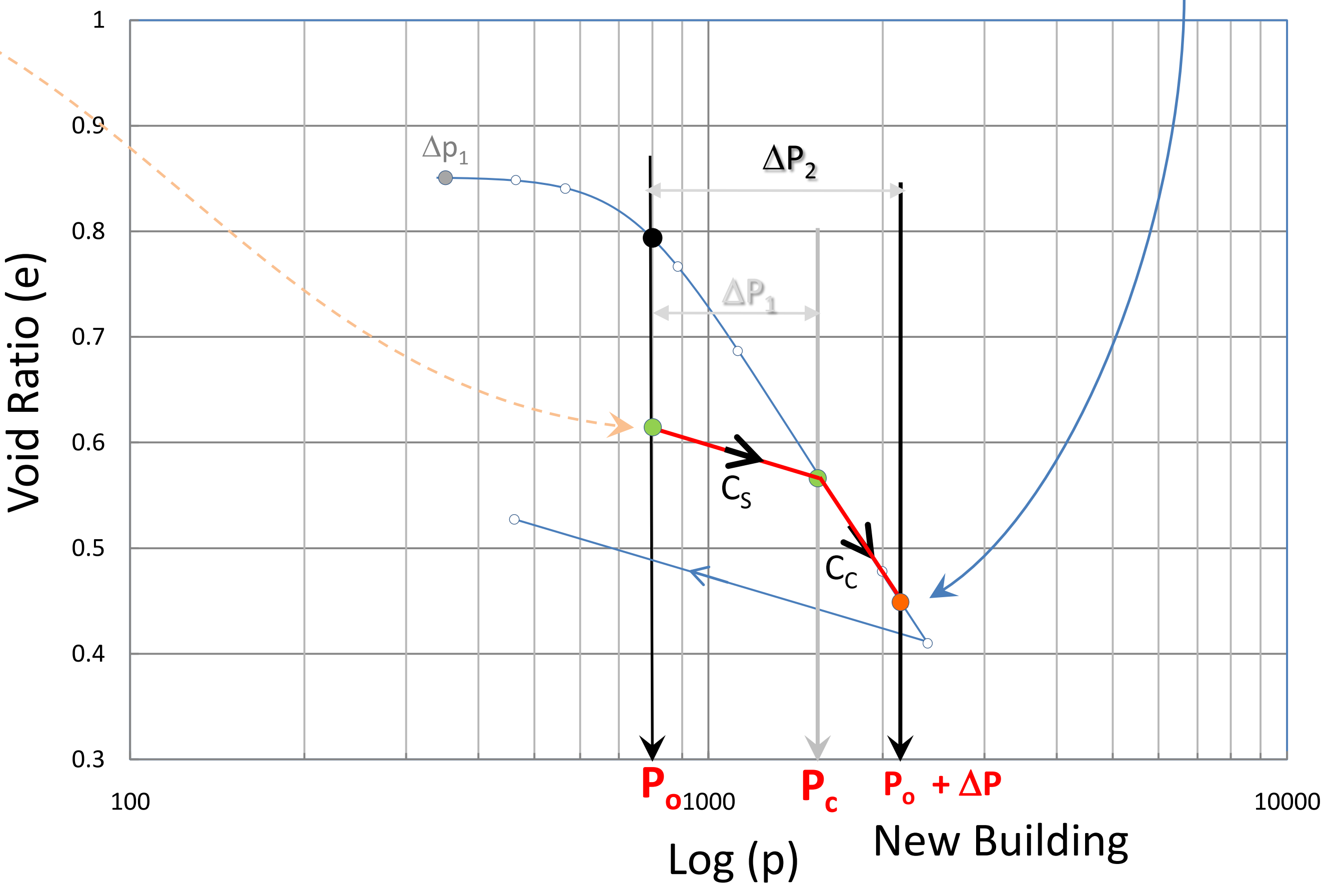
e_o = 0.61

Assume $P_o + \Delta p_2 = 2100$ psf

$$\Delta H = \frac{0.1 \times 16}{1 + 0.61} \log\left(\frac{1593.51}{803}\right)$$

$$+ \frac{0.72 \times 16}{1 + 0.61} \log\left(\frac{2100}{1593.51}\right)$$

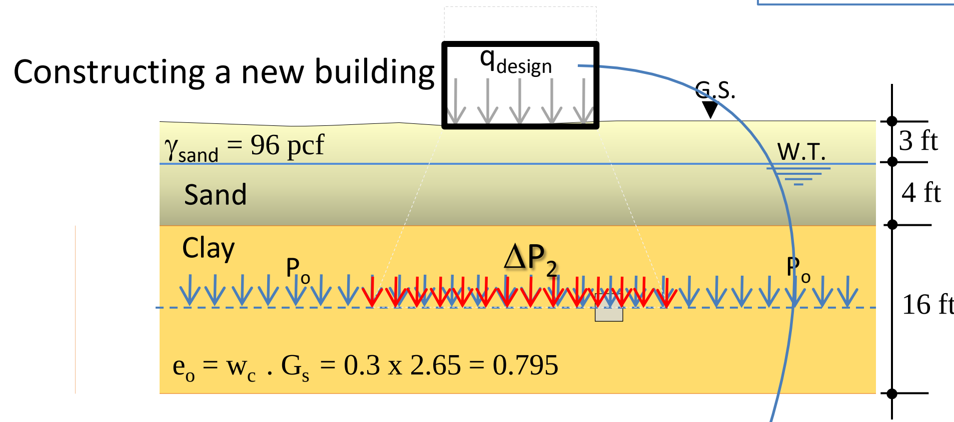
=



Scenario # 2

The soil now is overconsolidated Soil:

The new building is lighter in weight



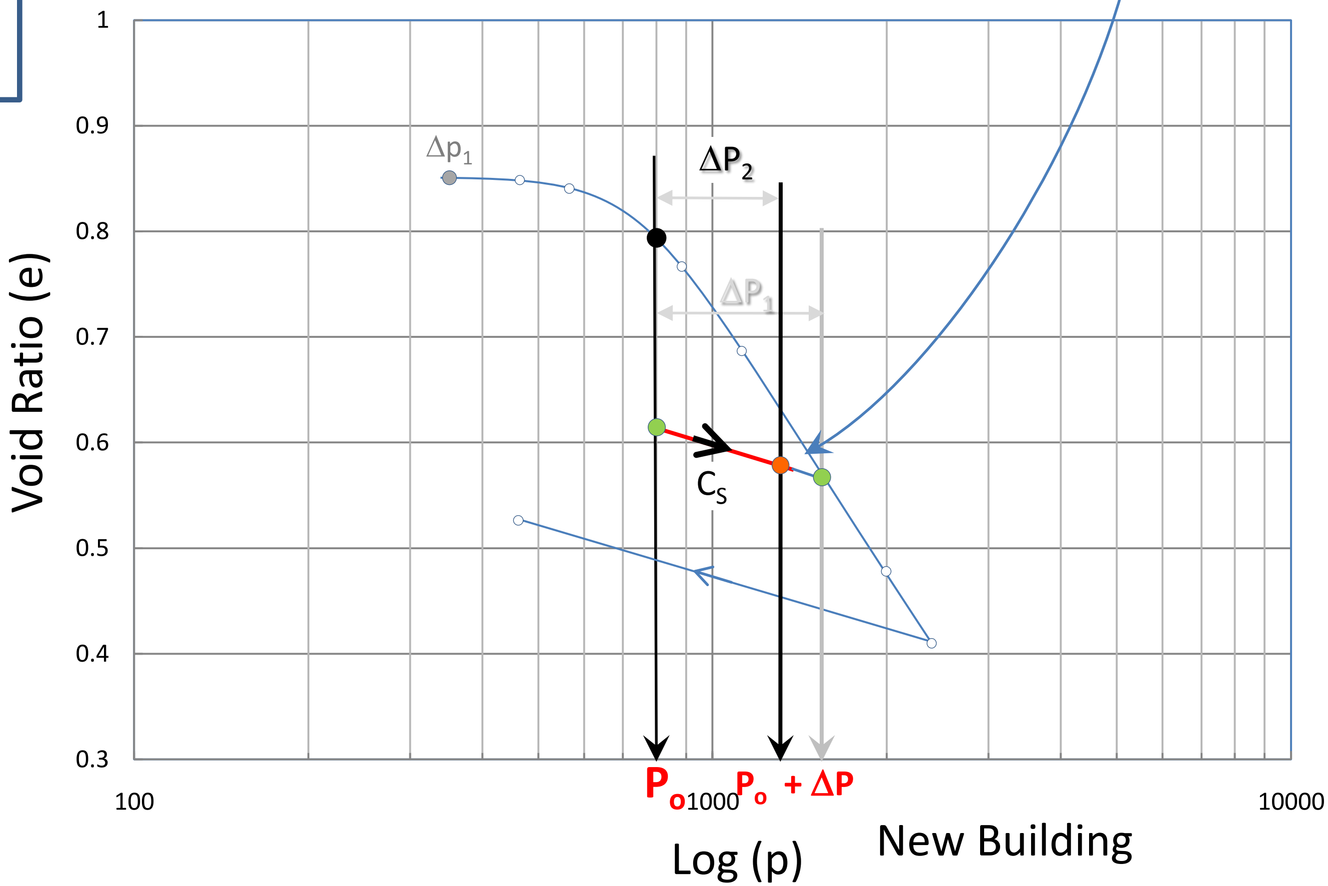
$$\Delta H = \frac{C_s H}{1 + e_o} \log \left(\frac{P_o + \Delta P}{P_o} \right)$$

$e_o = 0.61$

Assume $P_o + \Delta p_2 = 1600$ psf

$$\Delta H = \frac{0.1 \times 16}{1 + 0.61} \log \left(\frac{1600}{1593.51} \right)$$

=



Example of Semi-log Scale